Claims:

1. A method for processing sulfur-containing material derived from a source selected from the group consisting of sulfur-containing, carbon-containing fuel and gaseous combustion product of sulfur-containing, carbon-containing fuel, comprising

- providing a calcium sulfide-containing mixture derived from said source by reacting sulfur-containing material in said source with a calcium-containing material so as to produce said calcium sulfide-containing mixture further containing impurities;

- leaching a majority of said calcium sulfide from said calcium sulfide-containing mixture in a first aqueous solution containing hydrogen sulfide in an amount sufficient to dissolve said majority of said calcium sulfide in said first aqueous solution, so as to form a second solution containing calcium hydrosulfide;

- separating the second solution containing said calcium hydrosulfide from said impurities; and

- precipitating from the second solution a calcium-containing material selected from the group consisting of calcium carbonate and calcium hydroxide.

2. The method of claim 1, wherein said calcium sulfide-containing mixture is provided by reacting sulfur-containing material present in said source with a calcium-containing absorbent so as to form said calcium sulfide-containing mixture including said calcium sulfide and said impurities.

3. The method of claim 2, wherein said sulfur-containing material is sulfur dioxide, said source is said gaseous combustion product, and the reacting step is comprised of the following steps, wherein:

- said sulfur dioxide is absorbed from said gaseous combustion product in a calcium-containing absorbent so as to form a first mixture; and

- the first mixture is heated in the presence of a reducing agent so as to convert the first mixture into said calcium sulfide-containing mixture including said calcium sulfide and said impurities.

4. The method of claim 3 wherein said gaseous combustion product is from burning of sulfur-bearing fuel.

5. The method of claim 4 wherein said fuel is coal.

6. The method of claim 3 wherein said calcium-containing absorbent is selected from the group consisting of lime and limestone.

7. The method of claim 6 wherein said sulfur dioxide is absorbed in said calcium-containing absorbent by wet scrubbing with said absorbent, dry injection with said absorbent or slurry injection spray drying with said absorbent.

8. The method of claim 3 wherein said reducing agent is coal.

9. The method of claim 1 wherein said hydrogen sulfide is present in said first aqueous solution in excess of said amount sufficient to dissolve said majority of said calcium sulfide.

10. The method of claim 9 wherein said leaching is carried out in said first aqueous solution under a substantially oxygen-free atmosphere comprising hydrogen sulfide gas.

11. The method of claim 1 wherein calcium carbonate is precipitated from the second solution by carbonation with a gas containing carbon dioxide.

12. The method of claim 11 wherein said gas containing carbon dioxide is derived from said gaseous combustion product, and is substantially oxygen-free.

13. The method of claim 1, further including the steps of:

- removing hydrogen sulfide from said second solution; and

- converting the hydrogen sulfide removed from the second solution under oxidizing conditions, so as to form elemental sulfur.

14. The method of claim 13 wherein the converting step is conducted in the presence of an oxidizing agent.

15. The method of claim 14 wherein said oxidizing agent is air.

16. The method of claim 1, further including the steps of:

- removing hydrogen sulfide gas from said second solution;

- passing the removed hydrogen sulfide gas through a further calcium hydrosulfide-containing aqueous solution containing further hydrogen sulfide, so as to substantially scrub out any residual carbon dioxide in said removed hydrogen sulfide gas thereby forming substantially purified hydrogen sulfide gas.

17. The method of claim 16, further including the steps of:

- recycling the substantially carbon dioxide-free hydrogen sulfide gas to dissolve calcium sulfide in an aqueous solution; and

- converting the substantially purified hydrogen sulfide gas under oxidation conditions, so as to form elemental sulfur.

18. An apparatus for carrying out the method of claim 1, comprising:

- a leaching zone containing a calcium sulfide-containing mixture derived from a source selected from the group consisting of sulfur-containing, carbon-containing fuel and gaseous combustion product of sulfur-containing, carbon-containing fuel, within which leaching zone a majority of the calcium sulfide from said calcium sulfide-containing mixture is leached in a first aqueous solution containing hydrogen sulfide in an amount sufficient to dissolve said majority of said

calcium sulfide in said first aqueous solution, so as to form a second solution containing calcium hydrosulfide;

- a separation system connected to the leaching zone, through which the second solution containing said calcium hydrosulfide is separated from said impurities; and

- a precipitating zone operatively associated with the separating system, within which a calcium-containing material is precipitated from the second solution, said calcium-containing material being selected from the group consisting of calcium carbonate and calcium hydroxide.

19. The apparatus of claim 16, further comprising a heating zone for receiving a first mixture from an absorption zone, the absorption zone including a calcium-containing absorbent and receiving sulfur dioxide-containing gaseous combustion product, wherein sulfur dioxide from said gaseous combustion product is absorbed in the calcium-containing absorbent so as to form the first mixture, wherein, in the heating zone the first mixture is heated in the presence of a reducing agent so as to convert the first mixture into said calcium sulfide-containing mixture, said heating zone being connected to the leaching zone for introducing the calcium sulfide-containing mixture into the leaching zone.

20. The apparatus of claim 18, further including a system for removing hydrogen sulfide gas from said second solution.

21. The apparatus of claim 20, wherein said system for removing hydrogen sulfide gas from said second solution also converts the hydrogen sulfide gas removed from the second solution, under oxidizing conditions, so as to form elemental sulfur.

22. A method of processing a metal sulfur compound-containing material, comprising

- heating a first metal sulfur compound-containing mixture in the presence of a reducing agent, said metal being selected from the group consisting of calcium and strontium, the sulfur compound being selected from the group consisting of sulfates and sulfites, so as to convert the first metal sulfur compound-containing mixture into a second mixture including impurities and a corresponding metal sulfide of said metal;

- leaching a majority of said metal sulfide from said second mixture in a first aqueous solution containing hydrogen sulfide in an amount sufficient to dissolve said majority of said metal sulfide in said first aqueous solution, so as to form a second aqueous solution containing a corresponding metal hydrosulfide of said metal;

- separating the second solution containing said metal hydrosulfide from said impurities; and

- precipitating from said second solution a metal-containing material selected from the group consisting

of a metal carbonate of said metal and a metal hydroxide of said metal.

23. The method of claim 22 wherein said reducing agent is coal.

24. The method of claim 22 wherein said hydrogen sulfide is present in said first aqueous solution in excess of said amount sufficient to dissolve said majority of said metal sulfide.

25. The method of claim 24 wherein said leaching is carried out in said first aqueous solution under a substantially oxygen-free atmosphere comprising hydrogen sulfide.